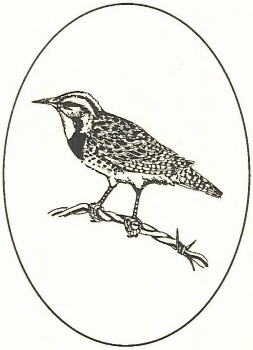
HABITAT RELATIONSHIPS AND BREEDING BIRDS ON THE SNAKE RIVER BIRDS OF PREY AREA



by Steven T. Knick
and
John T. Rotenberry

IDAHO BUREAU OF LAND MANAGEMENT TECHNICAL BULLETIN NO. 95-5 MARCH 1995

Habitat Relationships and Breeding Passerine Birds on the Snake River Birds of Prey Area

Authors

Steven T. Knick
Raptor Research and Technical Assistance Center
U.S. Bureau of Land Management
Boise, Idaho 83705

and

John T. Rotenberry
Natural Reserve System and Department of Biology
University of California
Riverside, California 92521

ANNUAL SUMMARY

We surveyed breeding passerine abundances throughout the Snake River Birds of Prey National Conservation Area at 145 sites sampled previously in 1991-1993. Analysis for habitat associations of species was similar to results from previous years: shrub-obligate species were associated with big sagebrush (Artemisia tridentata) or saltshrub habitats and disturbance, and grassland species, such as horned larks (Eremophila alpestris) and Western meadowlarks (Sturnella neglecta) were clustered in disturbance habitats. We monitored outcomes for nests of Brewer's sparrows (Spizella breweri) and sage thrashers (Oreoscoptes montanus). Brewer's sparrows were successful in fledging young at 11 of 15 nests, and sage thrashers were successful at only 4 of 13 nests. Nesting success was not associated with any local vegetation or landscape characteristics that we measured.

OBJECTIVE

To determine processes that influence the distribution and abundance of breeding passerine birds in fragmented shrubsteppe habitats in the Snake River Birds of Prey National Conservation Area.

INTRODUCTION

The effect of habitat fragmentation on biological diversity is an important consideration in the conservation of the earth's resources (Wilson 1988) because of detrimental effects on biodiversity and individual species distribution and abundance

(Saunders et al. 1991). From previous work in 1991-1993, we demonstrated the influence of fragmentation of shrubsteppe habitats on the distribution of passerine birds that breed in the Snake River Birds of Prey National Conservation Area (Knick and Rotenberry 1995). In 1994, we began a study to determine the process by which fragmentation influences the productivity of shrub-obligate passerine birds.

We tested the hypothesis that species productivity was independent of habitat and landscape characteristics for 3 species of shrub-obligate passerine birds: Brewer's sparrow, sage sparrow, and sage thrasher. Our objective was to determine causes of nest failure and relationship to fragmentation in shrubsteppe.

STUDY AREA

We conducted our study in approximately 200,000 ha of the Snake River Birds of Prey Area (116° E Long, 43° N Lat). Big sagebrush communities dominate the region in the north and grade into salt shrub communities in the south (Yensen and Smith 1983). Large-scale fires between 1980 and 1989 converted approximately one-half of the shrub communities to grassland areas of cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola iberica*) (Kochert and Pellant 1986). Primary land-use activities are livestock grazing and military training (Kochert and Pellant 1986). Temperatures during hot, dry summers average 30-36 C during June-August; average amount of annual precipitation at the Swan Falls weather station, located within the study area, is 26.9 cm.

METHODS

Point Count Surveys

We counted birds at 145 sites that had been surveyed for vegetation and birds in previous years (Rotenberry and Knick 1991, Rotenberry and Knick 1992, Knick and Rotenberry 1993). We sampled sites once during 30 April to 24 June between 0600 - 1000 hr on mornings that had little wind (<12 km/hr) and no rain. We recorded the number of all birds seen or heard for an unlimited-radius (Ralph et al. 1994) within a 5-min interval after a 1-2-min waiting period upon arrival at the site; we did not determine estimates of density. Minimum distance between sites was 400 m. Observers participated in a 1-3 week training period before sampling the bird sites.

We examined relationships between bird species and habitat variables by canonical correspondence analysis (CANOCO, ter Braak 1988). Canonical correspondence analysis is a multivariate direct gradient ordination of community variation (our avian species counts) relative to the environment (our habitat variables) (ter Braak 1986). In canonical correspondence analysis, the ordination axes of the set of bird species data are constrained to be linear combinations of the environmental variables, and species are assumed to have a unimodal response to the environmental gradients (ter Braak and Prentice 1988).

Vegetation data from bird count sites were previously sampled during 1991-1994 by Study 5 of the Bureau of Land Management/Idaho Army National Guard Research Project (Knick 1991, 1992, 1993; Watts and Knick, this volume). Variables used in the analysis included percent ground cover of dominant shrub, grass, and exotic annual species. We also included East and North UTM coordinates in the analysis. No landscape variables were used in the analysis of 1994 survey data.

Nesting Surveys

We systematically searched for nests of Brewer's sparrows, sage sparrows, and sage thrashers in sagebrush shrub patches from 16 May - 15 July. Nests with eggs or nestlings were revisited at 1-3 day intervals to determine nesting success and number of fledglings. After hatching, nestlings were weighed to 0.1 g with a Pesola scale. A nest was considered successful if nestlings survived 7 days for Brewer's sparrows (Petersen and Best 1987), 8 days for sage sparrows (Petersen and Best 1987), and 12 days for sage thrashers (Reynolds 1981).

Map coordinates of nests were determined by Global Positioning System (GPS). We processed raw GPS data using differential correction and data averaging (≥ 180 positions/location) with an accuracy estimated at <6 m for these combined techniques (August et al. 1994).

We measured percent ground cover of vegetation species within a 25-m radius of the nest site by a 1-m^2 point frame (Floyd and Anderson 1982) at 0, 5, 10, 15, 20, and 25-m distances away from the nest along a transect in each of the 4 cardinal directions. We determined the area, perimeter, and thickness of the patch in which the nest was located from the vegetation map translated from satellite imagery. Accuracy of the satellite image in distinguishing between shrub/nonshrub pixels was 80% (S.T. Knick, unpublished data). We also determined the nearest distance to the patch edge for each nest location. Cell size of the satellite map was 25 m and represents the resolution of our measurements.

We used logistic regression to determine environmental variables associated with successful and unsuccessful nests. Logistic regression is used to model the effects of continuous and discrete independent variables on a binary response (e.g., presence/absence) (McCullagh and Nelder 1989). All local vegetation and landscape variables (Table 1) were initially entered in the logistic regression (PROC LOGISTIC, SAS Statistical Institute 1990) model in a backwards elimination procedure (Manly et al. 1993, Trexler and Travis 1993). At successive steps, the least significant variable was removed if it did not contribute to significant differences (α <0.05) in the model fit to the data until no variables remaining in the model met this criterion.

RESULTS

Point Count Surveys

We sampled 146 sites for counts of breeding passerine birds. Vegetation data available from 134 sites were used in the canonical correspondence analysis. Relationships between bird species abundances and vegetation variables are summarized in Fig. 1. This biplot represents approximate values of the weighted averages of the bird species with respect to the vegetation variables. The numerical axes provide a framework for displaying quantitative relationships among bird species and vegetation variables, but otherwise have no intrinsic meaning.

The first axis represented a bird-vegetation canonical correlation of 0.83, whereas the second represented a correlation of 0.70 (Table 2). Together, they accounted for 75.3% of the bird-vegetation association.

Shrub-obligate species, such as sage and Brewer's sparrows, and sage thrashers were associated with big sagebrush or saltshrub communities (Fig. 1). In contrast, grassland and disturbance species, horned larks and meadowlarks were associated with disturbance vegetation communities (Fig. 1).

Table 1. Local vegetation characteristics and landscape attributes used in logistic regression analyses to develop resource selection models for breeding passerines in shrubsteppe habitats, southwestern Idaho.

Variable	Description
Winterfat	Percent ground cover
Shadscale	Percent ground cover
Russian thistle	Percent cover (indicator of disturbance)
Total grass cover	Percent cover of Sandberg's bluegrass, six-weeks
Patch area	Area of shrub patch size, determined from GIS
Patch perimeter	Perimeter of shrub patch, determined from GIS
Patch thickness	Thickness of shrub patch, determined from GIS

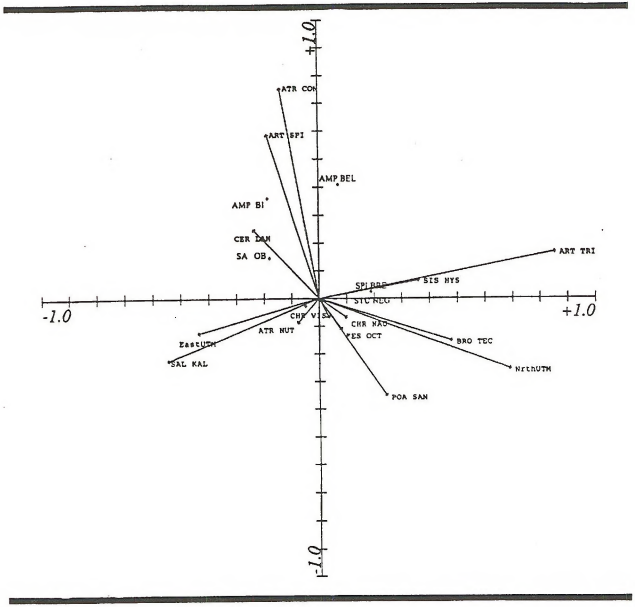


Fig. 1. Biplot of canonical correspondence analysis for birds species and percent ground cover of vegetation at survey sites. Birds species plotted were Brewer's sparrows (SPI BRE), sage sparrow (AMP BEL), black-throated sparrow (AMP BIL), and rock wren (SA OB). Vegetation species plotted were big sagebrush (ART TRI), shadscale (ATR CON), bud sagebrush (ART SPI), winterfat (CER LAN), Nuttall saltbush (ATR NUT), green rabbitbrush (CHR VIS), gray rabbitbrush (CHR NAU), cheatgrass (BRO TEC), Sandberg's bluegrass (POA SAN), bottlebrush squirreltail (SIS HYS), sixweeks fescue (FES OCT), and Russian thistle (SAL KAL). Also included were North and East UTM coordinates.

Table 2. Canonical correspondence analysis of bird species and percent cover values of vegetation at 134 sites. Numbers of birds were counted at each site during 1994; vegetation was sampled in previous years.

	Canonical Correspondence Axis			
	1	2	3	4
Eigenvalues	0.288	0.125	0.049	0.037
Species-environment correlations	0.826	0.704	0.512	0.400
Cumulative percentage variance				
of species data	15.5	22.2	24.9	26.9
of species-environment relation	52.5	75.3	84.1	90.9
Sum of all unconstrained eigenvalues	1.854			
Sum of all canonical eigenvalues	0.548			

Nesting Surveys

We located 6 nest sage sparrow nests, 19 Brewer's sparrow nests, and 16 sage thrasher nests. Only nest characteristics of Brewer's sparrows and sage thrashers were statistically analyzed for habitat associations of success because of sample sizes.

Brewer's sparrows were successful in fledging young at 11 of 15 nests. None of the local vegetation and landscape variables that we measured were associated with successful nests (Table 3).

Sage thrashers were successful in fledging young at only 5 of 14 nests. However, similar to Brewer's sparrows, none of the local vegetation and landscape variables we measured were associated with successful nests (Table 3).

DISCUSSION

The habitat associations derived from the canonical correspondence analysis were similar to those derived in previous years. Shrub-obligate species were associated with sagebrush or, to a lesser degree, saltshrub communities. In contrast, grassland and disturbance species, horned larks and meadowlarks were associated with disturbance vegetation communities.

Nesting success for Brewer's sparrows and sage thrashers was not related to any local vegetation or landscape characteristics that we measured. Sage thrashers had very low nest success, and we will attempt to determine causes in future work. We also caution that this was the first year of our study of productivity of shrubsteppe birds, and the results should be considered preliminary.

We earlier established the pattern of species distribution relative to fragmentation (Knick and Rotenberry 1995) but do not know the specific mechanisms by which fragmentation influences shrubsteppe species. Dispersal and reproductive rates of species and their degree of specialization and dependence on the fragmented resource (Urban and Shugart 1984, Fahrig and Paloheimo 1988), when coupled with patch size and interpatch distance (connectivity) of the habitats (Gardner et al. 1987, Burkey 1989) dictate benefits or loss due to habitat fragmentation. Birds in fragmented habitats have exhibited lower reproductive rates, higher predation rates, and higher rates of parasitism (Wilcove 1985, Temple and Cary 1988, Yahner and Scott 1988, Johnson and Temple 1990, Robinson 1992, Porneluzi et al. 1993, Paton 1994), and these mechanism all may operate in shrubsteppe habitats.

Previous research has documented microhabitat characteristics of nest placement and within territory habitat structures for numerous species within shrubsteppe habitats (e.g., Rich 1980a, 1980b, Reynolds 1981, Petersen and Best 1985a, Petersen and Best 1985b, Winter and Best 1985, Rotenberry and Wiens 1980a, Rotenberry and Wiens 1980b).

Table 3. Coefficients in logistic regression analysis of local vegetation and landscape characteristics associated with nesting success for Brewer's sparrows and sage thrashers.

	Step	Variable removed	Number in	Wald χ^2	Pr> χ^2
Brewer's sparrows					
	1	Thickness	9		
	2	Perimeter/area	8		
	3	Winterfat	7		
	4	Russian thistle	6	0.00005	0.9944
	5	Cheatgrass	5	0.000884	0.9763
	6	Sagebrush	4	0.000294	0.9863
	7	Grasses	3	0.00042	0.9836
	8	Perimeter	2	0.00106	0.9741
	9	Area	1	0.3337	0.5635
	10	Distance to grass	0	2.3750	0.1233
Sage thrashers					
	1	Thickness	9		
	2	Sagebrush	8	2.285E-8	0.9999
	3	Area	7	0.000011	0.9973
	4	Perimeter	6	0.00197	0.9646
	5	Winterfat	5	0.000149	0.9903
	6	Distance to Grass	4	0.0135	0.9075
	7	Cheatgrass	3	0.0643	0.7999
	8	Russian thistle	2	0.5211	0.4704
	9	Perimeter/area	1	0.8870	0.3463
	10	Grasses	0	2.8961	0.0888

However, interaction of landscape characteristics and processes of bird population dynamics have been difficult because of the inability to quantify attributes such as patch size and habitat evenness at large spatial scales more suited to management strategies. In this study, we now are examining habitats at both local and landscape scales to draw conclusions on structure of avian communities and species distribution and productivity.

PLANS FOR NEXT YEAR

We will repeat point counts with emphasis on sites surveyed in previous years. Because shrubsteppe birds in our study were influenced by landscape characteristics, we will to identify sites in marginal habitats and attempt to determine mechanisms limiting the presence of birds. We will increase our search effort to obtain larger sample sizes of nests for analysis of productivity relative to local and landscape characteristics.

ACKNOWLEDGMENTS

We thank Joe DeCruyenaere of the National Biological Survey, and Rafael Lara and Rod Scarpello of Boise State University for field assistance. Jamie Cavaille, and John DiGregoria assisted in collecting vegetation data. Satellite images were provided by the Bureau of Land Management's Global Climate Change Program. Funding was provided by the U.S. Bureau of Land Management Challenge Cost Share Program and the U.S. National Biological Survey. We appreciate administrative support from Mark Fuller, Mike Kochert, Jim Clark, Ann Debolt and Signe Sather-Blair.

LITERATURE CITED

August, P., J. Michaud, C. Labash, and C. Smith. 1994. GPS for environmental applications: accuracy and precision of locational data. Photogrammetric Engineering and Remote Sensing 60:41-45.

Burkey, T. V. 1989. Extinction in nature reserves: the effect of fragmentation and the importance of migration between reserve fragments. Oikos 55:75-81.

Fahrig, L., and J. Paloheimo. 1988. Determinants of local population size in patchy habitats. Theoretical Population Biol. 34:194-213.

Floyd, D. A., and J. E. Anderson. 1982. A new point frame for estimating cover of vegetation. Vegetatio 50:185-186.

Gardner, R. H., B. T. Milne, M. G. Turner, and R. V. O'Neill. 1987. Neutral models for the analysis of broad-scale landscape pattern. Landscape Ecol. 1:19-28.

Johnson, R. G., and S. A. Temple. 1990. Nest predation and brood parasitism of tallgrass prairie birds. J. Wildl. Manage. 54:106-111.

Knick, S. T. 1991. Habitat classification and the ability of habitats to support Townsend's ground squirrel and black-tailed jackrabbit populations. Pages 158-179 *in* K. Steenhof, ed. Snake River Birds of Prey Area Annu. Rep. U.S. Dep. Inter., Bur. Land Manage., Boise, Id.

Knick, S. T. 1992. Habitat classification and the ability of habitats to support Townsend's ground squirrel and black-tailed jackrabbit populations. Pages 247-275 *in* K. Steenhof, ed. Snake River Birds of Prey Area Annu. Rep. U.S. Dep. Inter., Bur. Land Manage., Boise, Id.

Knick, S. T. 1993. Habitat classification and the ability of habitats to support Townsend's ground squirrel and black-tailed jackrabbit populations. Pages 237-263 *in* K. Steenhof, ed. Snake River Birds of Prey Area Annu. Rep. U.S. Dep. Inter., Bur. Land Manage., Boise, Id.

Knick, S. T., and J. T. Rotenberry. 1993. Habitat relationships and breeding passerine birds on the Snake River Birds of Prey Area. Pages 341-352 *in* K. Steenhof, ed., Snake River Birds of Prey Area Annu. Rep. U.S. Dep. Inter., Bur. Land Manage., Boise, ID.

Knick, S. T., and J. T. Rotenberry. 1995. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. Conserv. Biol. In press.

Kochert, M. N., and M. Pellant. 1986. Multiple use in the Snake River Birds of Prey Area. Rangelands 8:217-220.

Manly, B., L. McDonald, and D. Thomas. 1993. Resource selection by animals. Chapman and Hall, London, U.K. 177pp.

McCullagh, P., and J. A. Nelder. 1989. Generalized linear models. Chapman and Hall, New York, N. Y.

Paton, P. W. C. 1994. The effect of edge on avian nest success: how strong is the evidence? Conserv. Biol. 8:17-26.

Petersen, K. P., and L. B. Best. 1985a. Nest-site selection by sage sparrows. Condor 87:217-221.

Petersen, K. P., and L. B. Best. 1985b. Brewer's sparrow nest-site characteristics in a sagebrush community. J.

Field Ornithol. 56:23-27.

Petersen, K. P., and L. B. Best. 1987. Effects of prescribed burning on nongame birds in a sagebrush community. Wildl. Soc. Bull. 15:317-325.

Porneluzi, P., J. C. Bednarz, L. J. Goodrich, N. Zawada, and J. Hoover. 1993. Reproductive performance of territorial ovenbirds occupying forest fragments and a contiguous forest in Pennsylvania. Conserv. Biol. 7:618-22.

Ralph, C. J., J. R. Sauer, and S. Droege. 1995. The use of point counts in avian ecological research. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. PSW-GTR 149. In press.

Reynolds, T. D. 1981. Nesting of the sage thrasher, sage sparrow, and Brewer's sparrow in southeastern Idaho. Condor 83:61-64.

Rich, T. D. G. 1980a. Nest placement in sage thrashers, sage sparrows, and Brewer's sparrows. Wilson Bull. 92:362-368.

Rich, T. D. G. 1980b. Territorial behavior of the sage sparrow: spatial and random aspects. Wilson Bull. 92:425-438.

Robinson, S. K. 1992. Population dynamics of breeding neotropical migrants in a fragmented Illinois landscape. Pages 408-418 *in* J. M. Hagan, III, and D. W. Johnston, eds. Ecology and conservation of neotropical migrant landbirds. Smithsonian Instit. Press. Washington, D.C.

Rotenberry, J. T., and S. T. Knick. 1991. Passerine surveys on the Snake River Birds of Prey Area. Pages 382-392 *in* K. Steenhof. ed., Snake River Birds of Prey Area Annu. Rep. U.S. Dep. Inter., Bur. Land Manage., Boise, Id.

Rotenberry, J. T., and S. T. Knick. 1992. Passerine surveys on the Snake River Birds of Prey Area. Pages 220-228 *in* K. Steenhof. ed., Snake River Birds of Prey Area Annu. Rep. U.S. Dep. Inter., Bur. Land Manage., Boise, Id.

Rotenberry, J. T., and J. A. Wiens. 1980a. Habitat structure, patchiness, and avian communities in North American steppe vegetation: a multivariate analysis. Ecology 61:1228-1250.

Rotenberry, J. T., and J. A. Wiens. 1980b. Temporal variation in habitat structure and shrubsteppe bird dynamics. Oecologia 47:1-9.

SAS Statistical Institute. 1990. SAS/STAT user's guide. Vol. 2. Version 6, 4th ed. SAS Statistical Institute, Cary, N.C. 1686pp.

Saunders, D. A., R. J. Hobbs, and C. R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conserv. Biol. 5:18-32.

Temple, S. A., and J. R. Cary. 1988. Modeling dynamics of habitat-interior bird populations in fragmented landscapes. Conserv. Biol. 2:340-347.

ter Braak, C. J. F. 1986. Canonical correspondence analysis: a new eigenvector method for multivariate direct gradient analysis. Ecology 67:1167-1179.

ter Braak, C. J. F. 1988. CANOCO - a FORTRAN program for canonical community ordination by [partial] [detrended] [canonical] correspondence analysis, principal components analysis and redundancy analysis.

Agric. Math. Group, Minist. Agric. and Fish. Tech. Rep. LWA-88-02. 95pp.

ter Braak, C. J. F., and I. C. Prentice. 1988. A theory of gradient analysis. Adv. Ecol. Res. 18:271-317.

Trexler, J. C., and J. Travis. 1993. Nontraditional regression analyses. Ecology 74:1629-1637.

Urban, D. L., and H. H. Shugart, Jr. 1984. Avian demography in mosaic landscapes: modeling paradigm and preliminary results. Pages 273-280 *in* J. Verner, M. L. Morrison, and C. J. Ralph, eds. Wildlife 2000: Modeling habitat relationships of terrestrial vertebrates. Madison, Wis.

Wilcove, D. S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. Ecology 66:1211-1214.

Wilson, E. O. 1988. Biodiversity. National Academy Press. Washington, D.C. 521pp.

Winter, B. M., and L. B. Best. 1985. Effects of prescribed burning on placement of sage sparrow nests. Condor 87:294-295.

Yahner, R. H., and D. P. Scott. 1988. Effects of forest fragmentation on depredation of artificial nests. J. Wildl. Manage. 52:158-161.

Yensen, D. L., and G. W. Smith. 1983. Big sagebrush-winterfat and big sagebrush-Nuttall saltbush mosaic vegetation in southwestern Idaho. Pages 28-33 *in* A. R. Tiedemann, E. D. McArthur, H. C. Stutz, R. Stevens, and K. L. Johnson, eds. Proc. symp. on the biology of *Atriplex* and related chenopods. Gen. Tech. Rep. INT-172. U.S. Dep. Agric., For. Serv., Intermountain For. Range Exp. Stn., Ogden, Ut

Bureau of Land Management
Idaho State Office
3380 Americana Terrace
Boise, Idaho 83706

BLM/ID/PT-95/009+1150